The effect of increased hydrogen mixing ratio on organic haze production on the early Earth

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The atmosphere of the early Earth may have contained an organic haze layer formed from methane, similar to that seen on Titan. Unlike Titan, early Earth's atmosphere is believed to have contained carbon dioxide as well as methane and nitrogen. The presence of oxygen atoms from carbon dioxide has been shown to reduce the amount of haze production, relative to a nitrogen/methane atmosphere.. Previous studies have focused on the haze properties for different C/O ratios of the atmosphere. In addition to oxygen, hydrogen may also have played a role in the chemistry of haze formation. Until recently, the escape of hydrogen early in Earth's history was assumed to be diffusion-limited, and therefore occurred at approximately the same rate as it does today assuming a constant exosphere temperature. However, recent work suggests that hydrogen may have been present in much higher amounts because the exosphere temperature may have been lower, due to the absence of molecular oxygen early in the atmosphere's history. At a lower rate of escape, hydrogen could have constituted up to 30% of the Earth's

atmosphere. The H/C ratio could then influence the haze production chemistry. We are performing lab experiments to probe how the presence of hydrogen changes haze production. Ongoing experiments produce haze particles using different concentrations of methane, carbon dioxide, and hydrogen with hydrogen levels up to 15% by volume. Aerosol composition as a function of reagent gas is measured using an aerosol mass spectrometer. Results of our experiment will be presented and the implications discussed.